2011 Cordilleran Tectonics Workshop

February 18-20
High Country Inn
Whitehorse, Yukon

Yukon Geological Survey
Miscellaneous Report 3

2011 Cordilleran Tectonics Workshop

High Country Inn, Whitehorse, Yukon

Friday, Feb. 18

6:00 PM	***Ice breaker + Registration***		
8:30 PM	***(cash bar + munchies)***		

Saturday, Feb. 19

		Speaker	*Abstract*
8:00 AM	***Registration*** ***coffee + muffins***		
8:30 AM	Uncovering the Thor-Odin dome: LA-ICP-MS detrital zircon data from the Thor-Odin dome cover sequence and tectonic implications thereof....	*Deanne van Rooyen*	***p. 32***
9:00 AM	An 811 Ma northwest-facing carbonate platform margin in the Fifteenmile Group of the Ogilvie Mountains	*Francis Macdonald*	***p. 17***
9:30 AM	~720Ma volcanism in the northwestern Cordillera: a far-flung component of the Franklin Igneous Event?	*Grant Cox*	***p. 7***
10:00 AM	***coffee + discussion + posters***		
10:30 AM	Iron isotope geochemistry of Rapitan iron formation: implications for genesis and global correlation	*Galen Halverson*	***p. 11***
11:00 AM	The Antler Orogeny, Nevada	*Jim Essman*	***p. 9***
11:30 AM	***posters + discussion***		
12:15 PM	***lunch*** ***posters + discussion***		
1:30 PM	Cretaceous deformation, metamorphism and exhumation within Yukon-Tanana terrane, west-central Yukon	*Reid Staples*	***p. 31***
2:00 PM	High-Temperature U-Pb Geochronology from the Grand Forks Complex, B.C. – Implications for Metamorphism and Exhumation	*Joel Cubley*	***p. 8***
2:30 PM	High-precision geochronology of Plutons in the southern Coast belt: Insights into Magma Residence, Magma Loading and Mechanisms of Arc Magmatism	*Dan Gibson*	***p. 9***
3:00 PM	Characterization and Structural Framework of Eocene Volcanic Sequences in the Nechako region of central British Columbia	*Esther Bordet*	***p. 2***
3:30 PM	Petrology of Ultramafic Xenoliths, Rayfield River and Big Timothy Mountain, areas, British Columbia	*Annie Greenfield*	***p. 10***
4:00 PM	***coffee***		
5:00 PM	***posters + discussion***		

7:00 PM	***dinner @ Antoinette's*** ***(*** *4121 - 4th Avenue* ***)***		

Sunday, Feb. 20

8:30 AM	***coffee + muffins***		
9:00 AM	An Early Cretaceous orogen in the southeastern Canadian Cordillera: Its relationship to the Late Cretaceous to Eocene thrust belt	*Philip Simony*	***p. 29***
9:30 AM	Eocene extension of the First and Second kind in the Internal zone of the southeastern Canadian Cordillera	*Sharon Carr*	***p. 3***
10:00 AM	Towards a Cretaceous paleogeography of NW Laurentia: untying the Tintina-Kaltag-Kobuk knot	*Don Murphy*	***p. 19***
10:30 AM	***coffee + discussion***		
11:00 AM	Cretaceous crustal structures in Yukon and implications for gold mineralization in the northern Cordillera	*Maurice Colpron*	***p. 6***
11:30 AM	Mid-Cretaceous dextral and sinistral fault systems in the northern Cordillera, northward escape of the Intermontane block, and the search for a plate tectonic moose-gooser	*JoAnne Nelson*	***p. 20***
12:00 PM	***lunch*** ***posters + discussion***		

Sunday, Feb. 20 (afternoon)

1:00 PM	Regional tectonic framework and metallogeny of the Coast Belt, southwest Yukon	*Steve Israel*	***p. 13***
1:30 PM	Contact relationships of the Kluane schist and adjacent rocks: evidence for an evolving tectonic boundary	*Ben Stanley*	***p. 30***
2:00 PM	Similarities between early Tertiary conglomerates along the Slate Creek and Duke River faults, Alaska and Yukon	*Chad Hults*	***p. 11***
2:30 PM	Zircon Ce4+/Ce3+ ratio determination by LA-ICP-MS microanalysis as a fingerprint of magmatic evolution and as a prospecting tool in porphyry Cu exploration	*John Chapman*	***p. 5***
3:00 PM	***Where to next year ??***		
	coffee		
	posters + discussion		
4:00 PM			

Posters

1	Newly found north striking dextral shear zone as potential evidence for (or roadblock to) Early Cretaceous sinistral duplication of the Coast Mountains batholith	*Joel Angen*	***p. 1***
2	The South Wernecke Mapping Project: a preliminary bedrock map for the 1:50K Mount Mervyn (106C/04) map sheet	*Joyia Chakungal*	***p. 4***
3	Identification Of A Crustal-Scale Extensional Structure in the Cordillera of West-Central Yukon	*Ellie Knight*	***p. 14***
4	Volcaniclastic gravity flow deposits in the Dezadeash Formation (Jura-Cretaceous), Yukon, Canada: Implications regarding the tectonomagmatic evolution of the Chitina arc in the northern Cordillera of North America	*Grant Lowey*	***p. 15***
5	Geological Investigations of the Basement of the Quesnel Terrane in Southern British Columbia	*Kathryn Lucas*	***p. 15***
6	Tectonic Subsidence Variations in the Jurassic of west-central Alberta	*Tannis McCartney*	***p. 18***
7	Proterozoic implications of the western extent of Dawson Thrust, Yukon	*Charlie Roots*	***p. 25***
8	New mapping in the Dawson Range - Whitegold district, Yukon	*Jim Ryan*	***p. 26***
9	Stratigraphy and structure of Yukon-Tanana terrane along the Early Mesozoic western North American continental margin, Tincup Lake area, southwest Yukon	*Steve Scott*	***p. 27***
10	Neoproterozoic and early Paleozoic correlations in the western Ogilvie Mountains	*Justin Strauss*	***p. 32***
11	Tectonothermal study of the interface between the Kootenay Arc, Priest River Complex and Purcell Anticlinorium in southeastern British Columbia.	*Ewan Webster*	***p. 33***
12	Latest compilation map of Alaska	*USGS*	
13	Yukon maps	*YGS*	
14	BC map	*BCGS*	

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Newly found north striking dextral shear zone as potential evidence for (or roadblock to) Early Cretaceous sinistral duplication of the Coast Mountains batholith

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Northwest striking sinistral shear zones have been well documented on Porcher Island and the surrounding area (Roddick, 1970; Chardon et al., 1999; Nelson et al., 2010). These include the Grenville Channel, Barrett, and Chismore Passage shear zones (part of this study), as well as the Kitkatla and Principe-Laredo shear zones to the south. Timing of this deformation is not well constrained. Complex crosscutting relationships with several intrusions assumed to be part of a suite dated between 113 Ma and 103 Ma, provides an approximate Albian age (Butler et al., 2006). A K-Ar cooling age for biotite of 87 Ma provides a younger limit on deformation along the Grenville Channel shear zone (van der Heyden, 1989). As of yet no displacement magnitudes are known. These shear zones have been implicated in sinistral duplication of the Coast Mountains batholith (Gehrels et al., 2009).

Fieldwork during the summer of 2010 revealed the existence of a north striking dextral shear zone along Telegraph Passage. The timing relationship between this shear zone and the northwest striking ones will hopefully be elucidated by U-Pb geochronology samples currently being processed at the Jack Satterly Geochronology Laboratory. Based on their similar style of deformation and the presence of north striking dextral kink bands along the Chismore Passage shear zone, it seems likely that these two shear zones were active at the same time. If these do turn out to be a high angle conjugate shear set, the stress regime required is incompatible with the proposed 800 km of sinistral displacement to duplicate the Coast Mountains batholith. Alternately, the dextral shear zone may turn out to be the northern continuation of a dextral shear zone on the south side of Grenville Channel approximately 100 km to the southeast (Chardon et al., 1999 and references therein). Perhaps this dextral shear formed as a conjugate Riedel shear to an overall sinistral system. This interpretation strongly supports the sinistral duplication model. It is clear that a complete understanding of the relationship of these sinistral and dextral shear zones will have a significant impact on our understanding of the Cretaceous tectonic history of the Alexander Terrane.

References:

Butler, R.F., Gehrels, G.E., Hart, W., Davidson, C. and Crawford, M.L. (2006): Paleomagnetism of Late Jurassic to mid-Cretaceous plutons near Prince Rupert, British Columbia; *Geological Association of Canada*, Special Paper 46, pages 171–200.

Chardon, D., Andronicos, C.L. and Hollister, L.S. (1999): Large-scale transpressive shear zone patterns and displacements within magmatic arcs: the Coast Plutonic Complex, British Columbia; *Tectonics*, Volume 16, pages 278-292.

Gehrels, G.E., Rusmore, M., Woodsworth, G., Crawford, M., Andronicos, C., Hollister, L., Patchett, J., Ducea, M., Butler, R., Klepeis, K., Davidson, C., Friedman, R., Haggart, J., Mahoney, B., Crawford, W., Pearson, D. and Girardi, J. (2009): U-Th-Pb geochronology of the Coast Mountains batholith in north-coastal British

Columbia: constraints on age and tectonic evolution; *Geological Society of America Bulletin*, Volume 121, pages 1341-1361.

Nelson, J.L., Mahoney, J.B., Gehrels, G.E., van Staal, C., Potter, J.J. (2010): Geology and mineral potential of Porcher Island, northern Grenville Channel and vicinity, northwestern British Columbia; *BC Ministry of Energy, Mines and Petroleum Resources; Geological Fieldwork 2009*, Paper 2010-1. pages 19-42.

Roddick, J.A. (1970): Douglas Channel and Hecate Strait; *Geological Survey of Canada*, Map 23 - 1970, Paper 70-41.

van der Heyden, P. (1989): U-Pb and K-Ar geochronometry of the Coast Plutonic complex, 53°N to 54°N, British Columbia, and implications for the Insular-Intermontane terrane boundary; unpublished PhD thesis, *The University of British Columbia*, 392 pages.

Characterization and Structural Framework of Eocene Volcanic Sequences in the Nechako region of central British Columbia

Esther Bordet and Craig J.R. Hart - *MDRU-Mineral Deposit Research Unit, Earth and Ocean Sciences, The University of British Columbia*

Thick, discontinuous sequences of Eocene volcanic rocks cover over 15,000 km^2 of the Nechako region, central British Columbia. They unconformably overlie Jura-Cretaceous basin clastic sedimentary rocks and are extensively masked by Neogene subaerial Chilcotin flood basalts and Quaternary glacial sediments. A limited number of mineral exploration prospects have been discovered in this region, despite the recognized economic potential of volcanic and plutonic rocks from the Jurassic to the Eocene in adjacent areas. In addition, Jura-Cretaceous basin rocks have some hydrocarbon potential, but their stratigraphy has been extensively complicated by Eocene thermal and structural overprinting. In this project, characterization of the nature, thickness and structural framework of Eocene volcanic rocks will provide new insights into the geological understanding of this part of central British Columbia, and will facilitate future exploration efforts for natural resources.

Eocene volcanic rocks erupted between 53 and 45 Ma (U-Pb and Ar-Ar ages; Grainger et al., 2001) and likely used major structures formed during a regional scale transtensional event as conduits towards the surface. These structures include Late Cretaceous to Early Eocene northwest-trending extensional and dextral faults such as the Yalakom fault, which are associated with Early Cenozoic pull-apart basins (Struik, 1993). Coeval normal to strike-slip northeast-trending faults are associated with Eocene dikes (Lowe et al., 2001). From the Early Eocene to the Early Oligocene, northwest-directed extension generates north-trending en echelon fault systems such as the regional dextral Fraser fault.

In the field, the nature, structure and extent of the different packages of volcanic sequences currently inferred to be Eocene in age were documented, as well as their relationships with underlying and overlying rocks. The project was focused along existing seismic and magnetotelluric surveys in order to recognize three dimensional structural relationships. Along the Nazko River, Eocene massive to columnar jointed basalt and andesite flows and associated autobreccia, as well as minor felsic ash deposits overlie the deformed Cretaceous clastic rocks. East of the Nazko River, the oil exploration well B-16-J sampled 1800m of Paleocene-Eocene interbedded conglomerate, sandstone and tuff overlain by Eocene mafic volcanics. North of this well, a broad unit of Early Eocene banded biotite-phyric rhyolite tuff was mapped over a distance of 20km. It is in contact to the east with coherent mafic and intermediate lava flows, autoclastic flow breccias and block and ash flow deposits. West of the Nazko River, volcaniclastic rocks and volcanic breccias dominate, in association with coherent basaltic, andesitic and felsic volcanic rocks. In this area, well B-22-K intersected 3500m of Early Eocene to Oligocene volcanic rocks, including plagioclase-phyric andesite and breccias, interbedded volcanic flows and volcaniclastic rocks.

These observations corroborate interpretations from magnetotelluric datasets where a shallow conductive layer ranging in depth from 0 to 4000m is regionally correlated with the surface-mapped Eocene volcaniclastic rocks (Spratt and Craven, 2010). Seismic interpretations (Smithyman, 2010; Hayward and Calvert, in press) suggest the development of fault-bounded pull-apart basins during the Eocene infilled with the products of extensive volcanism.

Grainger, N.C., Villeneuve, M.E., Heaman, L.M. and Anderson, R.G. (2001): New U-Pb and Ar-Ar isotopic age constraints on the timing of Eocene magmatism, Fort Fraser and Nechako River map areas, central BC; Can. J. Earth Sci., v. 38., p. 679–696.

Hayward, N. and Calvert, A.J. (in press): Interpretation of structures in the south-eastern Nechako Basin, British Columbia, from seismic reflection, well log and potential field data; Can. J. Earth Sci.

Lowe, C., Enkin, R.J. and Struik, L.C. (2001): Tertiary extension in the central BC intermontane belt: magnetic and paleomagnetic evidence from the Endako region; Can. J. Earth Sci., v. 38, p. 657–678.

Smithyman, B.R. and Clowes, R.M. (2011): Improved near-surface velocity models from the Nechako Basin seismic survey, south-central British Columbia (parts of NTS 93B, C, F, G), part 2: full-wave form in version; *in* Geoscience BC Summary of Activities 2010, Geoscience BC, Report 2011-1, p. 255–264.

Spratt, J.E. and Craven, J.A. (2010): Magnetotelluric imaging of the Nechako Basin, British Columbia; *in* Current Research 2010-3, Geological Survey of Canada, 9 p.

Struik, L.C. (1993): Intersecting intracontinental Tertiary transform fault systems in the North American Cordillera; Can. J. Earth Sci., v. 30, p. 1262–1274.

Eocene extension of the First and Second kind in the Internal zone of the southeastern Canadian Cordillera

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The ~400 km wide, east-verging, retrowedge side of the southeastern Canadian Cordillera was predominantly formed during the Cretaceous to Eocene. The External zone, in the Rocky Mountains and Foothills, is characterized by Late Cretaceous to Eocene thin-skinned thrust and fold systems that root into a basal décollement. The Western Internal zone is characterized by tracts of metamorphic rocks and metamorphic core complexes (e.g. Kettle, Okanagan, Priest River and Valhalla complexes), some of which are basement-cored domes (e.g. Frenchman Cap, Thor-Odin, Spokane). Some of these complexes are bounded by ductile and/or brittle extensional fault systems that contributed, at least in part, to their exhumation in the Early Eocene. Motion on some of the easterly dipping normal fault systems is as old as ca. 59-58 (e.g. Valkyr shear zone) and ca. 55 Ma (e.g. Columbia River fault system). These extensional fault systems of the “First Kind” are interpreted to have formed in response to local crustal thickening in the Internal zone. They merge with mid-crustal detachments, including existing décollements, and could have been active during episodes of thrusting in the eastern Front Ranges and the

Foothills. Extensional ductile – brittle detachment systems in the Internal zone that have motion that is ca. 52-51 Ma or younger (e.g. Okanogan - Okanagan – Eagle River Valley fault system) coincided with a period voluminous magmatism, some of which had contributions from mantle sources. In addition, N-S steep brittle faults and late dykes are pervasive throughout the western Internal zone. This stage of extensional faulting, of the "Second Kind," is interpreted to represent a change in tectonic regime to crustal-scale extension in the Internal zone, and coincided with or followed the end of thrusting in the External zone. This suggests that thrust faulting after ca. 55 Ma is plausible but after ca. 51 Ma is unlikely.

The South Wernecke Mapping Project: a preliminary bedrock map for the 1:50K Mount Mervyn (106C/04) map sheet

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An integrated bedrock mapping and regional soil sampling program in the Mount Mervyn map area (106C/04) was undertaken in 2010. It is the first of a multi-year initiative called the South Wernecke mapping project (SWP), which spans ten 1:50K map sheets in the southern Wernecke Mountains area in central Yukon. Field work in the first year has served to highlight the complexities of the bedrock geology in the region, and identify areas of mineral potential. Preliminary bedrock mapping results are presented here.

Field observations have permitted division of the Mount Mervyn map area into three lithologically and structurally distinct domains herein referred to as the Southern; Central; and Northern domains. Rocks comprising the Southern domain include all rocks south of the Dawson Thrust. They are exposed along the ridges north of the Stewart River and through much of the Nadaleen Range, where they sit in the hanging wall of the Dawson Thrust. Units that have been correlated with the Neoproterozoic – lower Cambrian Hyland Group (Gordey and Anderson, 1993) occupy the lowest structural levels of the Dawson Thrust sheet and are structurally overlain by units that have been correlated with the Devonian – Mississippian Earn Group. Where primary structures could be identified, stratigraphic up is predominantly to the south. The exact nature (unconformity versus thrust fault) of the contact between the two sedimentary sequences is unclear. Older rock units in the structurally lower part of the thrust stack are deformed into north-verging folds, while Earn Group equivalent rocks have been tightly folded and subsequently refolded into large-scale, upright, open east-west folds

The Central domain includes rocks north of (*i.e.*, in the footwall of) the Dawson Thrust and south of the Kathleen Lakes Fault. It is divided into four, east-striking units (C1-C4) that are tentatively correlated with Devono – Mississippian and younger rocks to the west, as described by Abbott (1990). Units have been deformed into north-verging folds, as seen to the south in the lowest structural levels of the Dawson Thrust stack.

Rocks of the Northern domain comprise an overall eastward-younging package of siliciclastic and carbonate rocks. Siliciclastic rocks in the region were previously mapped as Hyland Group that is unconformably overlain by platform carbonate rocks of the Cambrian – Devonian Bouvette Formation (Gordey and Makepeace, 2001). Mapping in 2010 have revealed that siliciclastic rocks do not resemble Hyland Group rocks as mapped in the Southern domain. Further mapping and acquisition of geochronological constrains will be required before a stratigraphic correlation can be proposed with confidence. The nature of the contact between the Central and North domains across the Kathleen Lakes structure remains unclear (*i.e.* thrust or strike-slip). Foliation development is restricted to the older siliciclastic units and may be related to the development of the penetrative east trending fabric observed in the Southern and Central domains.

Zircon Ce^{4+}/Ce^{3+} ratio determination by LA-ICP-MS microanalysis as a fingerprint of magmatic evolution and as a prospecting tool in porphyry Cu exploration

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Numerous studies suggest that a genetic link exists between oxidized magmas and porphyry-style Cu (± Au ± Mo) mineralization. It is therefore both commercially and scientifically important to determine whether this association is robust and, if so, whether it can be used as a reliable indicator of the prospectivity of intrusive igneous bodies. However, traditional indicators of magmatic redox state – such as whole-rock Fe^{3+}/Fe^{2+} ratio and oxide mineralogy – can be reset during both hydrothermal alteration and surficial weathering.

Zircon ($ZrSiO_4$) is an abundant accessory mineral in granitoid igneous intrusive rocks, and is both refractory and resistant to alteration. As such, it preserves its primary crystallization chemical composition even where the parent rock has been hydrothermally altered, or subjected to intense physical and/or chemical weathering. Trivalent heavy rare earth elements readily substitute for Zr within the zircon crystal lattice, but the degree of substitution decreases markedly with increasing ionic radius. Hence, the light rare earth elements are relatively excluded, with distribution coefficients readily predictable by calculation from a standard lattice-strain model. Both Ce and Eu show significant deviations from this model behaviour, however, due to their additional stable +4 and +2 oxidation states, respectively. Zircon commonly displays a significant positive Ce anomaly, as Ce^{4+} is preferentially incorporated into the zircon lattice over Ce^{3+} due to its identical charge to Zr^{4+}. The magnitude of this anomaly correlates directly with the Ce^{4+}/Ce^{3+} ratio in the parent magma, and as such can be used as a qualitative proxy for oxidation state.

In this study, we used laser-ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS) microanalysis to determine zircon Ce^{4+}/Ce^{3+} ratios and U-Pb ages for a suite of granitoid intrusions from southern and western Yukon. Much of the Yukon remained ice-free during the last glacial maximum, in contrast to the majority of the rest of Canada, and as a consequence the depth and degree of surficial weathering is commonly greater than is present elsewhere. Sampling was conducted at a number of scales, from detailed investigation of individual phases within a single intrusive stock, to regionally extensive reconnaissance sampling of pluton and batholith complexes across the territory. Initial results show that LA-ICP-MS microanalysis allows deconvolution of magmatic redox evolution within a long-lived igneous system, and can fingerprint phases associated with economically significant base metal mineralization.

Cretaceous crustal structures in Yukon and implications for gold mineralization in the northern Cordillera

Maurice Colpron[1], Don Murphy[1], JoAnne Nelson[2]

[1] Yukon Geological Survey
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The northern Intermontane terranes of south-central Yukon and northern British Columbia are dissected by a series of dextral strike-slip faults, including the Kechika, Cassiar and Teslin-Thibert-Kutcho faults. In southern Yukon, the Teslin fault is a major northwest-striking, northeast-dipping fault that can be traced down to ~7-8 seconds (~20 km) in seismic profiles. It probably originated as a southwest-verging thrust fault in Jurassic, possibly rooting into a subduction megathrust, and was later reactivated as a strike-slip fault in Cretaceous. Up to 130 km of dextral displacement has been suggested on the Thibert fault in northern B.C. Farther north in Yukon, the Teslin fault progressively loses stratigraphic separation (and presumably displacement), juxtaposing Laberge Group strata (Whitehorse trough) or similar augite-phyric volcanic rocks of Stikinia and Quesnellia on either sides. This apparent lack of offset along Teslin fault in central Yukon could be accounted by progressively 'bleeding' displacement to a series of subsidiary faults, including the d'Abbadie, Big Salmon and Tadru faults, which show collectively up to 125 km of dextral displacement. These subsidiary faults are curvilinear and have a more northerly strike than the Teslin. They are truncated by the Tintina fault, which has an estimated 430 km of Eocene dextral displacement. Possible counterparts of the Big Salmon-d'Abbadie-Tadru fault array northeast of the Tintina fault may be found in poorly understood structures of the Hyland River region of southeast Yukon. This north-trending structural corridor extends northward to northwest-striking, dextral faults of the Hess-Macmillan system, near the Yukon-NWT boundary. These in turn feed into the northwest-directed Tombstone thrust fault to the west. Offset equivalent of the Tombstone thrust southwest of the Tintina fault can be found in the Beaver Creek thrust near Fairbanks, Alaska. Collectively these faults define the northeast edge of a northwest-transported crustal block within the peri-Laurentian realm of the northern Cordillera.

Displacement along these northwest-directed faults is closely associated with emplacement of Early to mid-Cretaceous plutons in Yukon. This relationship is particularly evident along Cassiar and d'Abbadie faults where localized ductile strain in granites indicate synkinematic intrusion. These relationships indicate that dextral strike-slip displacement along the Teslin fault system is mainly mid-Cretaceous in age (*ca*. 115-95 Ma). Furthermore, the close association between faulting and plutonism is likely responsible for the strong northwest-trending linearity of many Early to mid-Cretaceous batholiths in the northern Cordillera (e.g. Cassiar and Dawson Range batholiths). Northeast of the Tintina fault, voluminous Early to mid-Cretaceous plutons (e.g. Mount Billings batholith) were probably emplaced within zones of northwest-directed extension.

These Cretaceous faults provide the structural framework within which many significant gold and copper-gold occurrences were developed in the northern Cordillera. Northeast of Tintina fault, structures associated with the Tombstone thrust provided the ground preparation for 94-92 Ma mineralization associated with the Tombstone plutonic suite (e.g. Brewery Creek, Dublin Gulch, Gold Dome). Farther south, gold mineralization along the Hyland River trend includes Hyland Gold and recent discovery at the 3 Ace property. Southwest of the Tintina, gold mineralization is closely associated with the Big Salmon and d'Abbadie faults (e.g. Livingstone placers), an area that has seen limited hardrock exploration to date. Faults of the Teslin system also apparently extend northwesterly into the Dawson Range, where structures with overall small displacement (e.g. Big Creek fault) are associated with a range of gold and copper-gold occurrences (e.g. Mount Freegold, Mount Nansen, Sonora Gulch). Important discoveries farther west (e.g. Whitegold, Coffee, Casino) also occurs along this trend but are also associated with younger, northeast- and north-trending faults; structures that are prominent in eastern Alaska but only locally recognized so far in Yukon.

~720Ma volcanism in the northwestern Cordillera: a far-flung component of the Franklin Igneous Event?

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The Neoproterozoic Tatonduk Inlier, spanning the Alaskan-Yukon border, contains the Pleasant Creek Volcanics, which are composed of mafic lavas and a large arcuate dyke swarm. Previous K/Ar ages for the dykes range from 532 ± 11 Ma to 644 ± 18 Ma and appear to be inconsistent with geological constraints and correlations between the Tatonduk strata and the Neoproterozoic sequence of the well-dated Coal Creek Inlier to the east.

Firstly, we present a new correlation that dates the Pleasant Creek Volcanics to ~720 Ma
based on the correlation of the Tindir Ironstones to the Rapitan Group of the Mackenzie Mountains. Secondly, we present major and trace element analysis for the Pleasant Creek Volcanics. These mafic flows and dykes exhibit calc-alkaline affinity and plot as arc related basalts on all major tectonic discriminate diagrams. Furthermore, major element modeling utilising the MELTS thermodynamic model suggests $f O_2$ of FMQ+2.5 to 3.0, values normally associated with arc volcanism.

Viewed in isolation the geochemistry of these mafic volcanics could be interpreted as being of continental arc affinity. However, this interpretation is inconsistent with the passive margin sedimentary sequence that host these volcanics. We suggest that the Pleasant Creek Volcanics are coeval with known occurrences of continental flood volcanism and propose a testable model that reconciles the geochemistry with the observed sedimentary sequence and links the Pleasant Creek Volcanics to the Franklin Igneous Event.

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High-Temperature U-Pb Geochronology from the Grand Forks Complex, B.C. – Implications for Metamorphism and Exhumation

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Metasedimentary gneisses of the Proterozoic Grand Forks Group (GFC) experienced high-temperature, ~2.5kbar exhumation in the late Paleocene to early Eocene, coincident with the transition from compression to extension in the hinterland of the Canadian Cordillera. New uncorrected LA-ICP-MS U-Pb monazite ages from the stratigraphically lowest and intermediate pelite units (Units I and III) yield new information about the timing of Late Cretaceous metamorphism and subsequent Eocene high-T exhumation. These ages expand upon preliminary dating results from Laberge and Pattison (2007, CJES). Three broad generations of monazite exist, which individually may be mixtures of a number of discrete metamorphic events. Many monazites display resorbed, uranium-rich cores of Generation 1 (138±5 Ma, range 116-157 Ma, n= 26), surrounded by intermediate, variably resorbed zones of Generation 2 (92±2 Ma, range 76-111 Ma, n=75). Generation 3 monazite (62±1.2 Ma, range 50-76 Ma, n=109) forms thin rims and overgrowths on Generation 2 monazite. One detrital monazite recorded concordant core ages averaging 1992±60 Ma.

Generation 1 monazite growth is interpreted as the result of a well-documented Late Cretaceous metamorphic and magmatic episode between 140-120 Ma (e.g. Parrish, 1995; CJES), related to accretion of the allochthonous Intermontane terrane to the North American margin. While Generation 1 cores are common in monazites from Unit I, they are largely absent from the overlying Unit III, which recorded only a single age older than 111Ma (132±9 Ma). Generation 2 monazite growth is interpreted as a protracted period of prograde metamorphism in the Late Cretaceous, and overlaps with documented 85-75 Ma metamorphism in the nearby Valhalla Complex (Spear, 2004; Int. Geol. Rev.). The dominant population within the GFC, Generation 3, is proposed to represent monazite growth as a result of garnet breakdown and anatexis related to the high-T exhumation of the GFC. Generation 3 monazites found as inclusions in biotite selvages likely related to the back reaction of melt with mesosome have rim ages of 57-50 Ma. Unzoned monazites found as inclusions in Kfs+Qtz-rich leucosomes display the youngest Generation 3 ages, and are interpreted to have crystallized directly from the melt, with no inherited cores. This is consistent with recent U-Pb monazite estimates for peak metamorphism in the Valhalla Complex of 62-57Ma (Gordon et al., 2008; Tectonics).

The dominant monazite age population (Generation 3) encompasses a new U-Pb zircon SHRIMP age of 59.5±0.6Ma for the emplacement of Ladybird-suite leucogranite on the eastern margin of the core complex. Similar to what has been proposed for the Valhalla Complex by Simony and Carr (1997; J. Structural Geology), the emplacement of the Ladybird suite may have provided a weak horizon to facilitate high-T uplift of the complex. A new U-Pb zircon age from ductilely deformed, anatectic pegmatite in Unit I (51.2±0.6 Ma) overlaps with the youngest Generation 3 ages, and supports the interpretation that this population was partially the result of leucosome crystallization following decompression melting. Ductile shear fabrics are cut by 50±0.85 Ma undeformed granites, indicative of a cessation of high-T uplift by that time. These high-temperature U-Pb ages extending down to ~50Ma require extremely rapid cooling to reach K-Ar biotite closure at 49.2±2.9Ma (weighted average). In addition, they call into the question the accuracy of preexisting K-Ar hornblende data with ages averaging 60.6±2.1Ma, which anchored the slower-cooling T-t path of Laberge and Pattison (2007, CJES). The combination of new dates with K-Ar biotite geochronology and microtextural evidence suggests fast exhumation followed by fast cooling in the early Eocene.

The Antler Orogeny, Nevada

Jim Essman, Newmont North American Exploration

The late Devonian to late Mississippian Antler orogeny is typically characterized as the eastward emplacement of older deep-water basinal facies rocks structurally above coeval and younger shallow-water facies rocks. The mechanism of eastward transport for the deep-water rocks is known as the Roberts Mountains thrust fault. Regionally, this event resulted in the formation of a hinterland known as the Antler highland in central Nevada, and an associated foreland basin in eastern Nevada. Critical evaluation of vertical and lateral facies successions during the late Devonian and early Mississippian in north central Nevada yields vital clues, and raises questions, as to the nature of the Antler orogeny. For example; a newly recognized late Devonian fossiliferous and tuffaceous siltstone unit could provide direct evidence of an existing Antler island arc, widely postulated to have existed and to have been the driving force for the orogeny itself but to date one has not been directly observed. This talk will summarize both local tectonic and eustatic events manifested in the stratigraphic record of north central Nevada and their relationship to the Antler orogeny.

High-precision geochronology of Plutons in the southern Coast belt: Insights into Magma Residence, Magma Loading and Mechanisms of Arc Magmatism

Dan Gibson et al.

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The Coast Plutonic Complex was a long-lived magmatic arc situated along the Mesozoic convergent margin of NW North America. The complex interplay between arc magmatism, terrane accretion and attendant deformation and metamorphism is evident in the Harrison Lake area of southern British Columbia, where Mesozoic plutons have been instructive regarding mechanisms of pluton emplacement in a convergent arc setting. Brown and McClelland (GSAB 2000) interpreted the plutons to have formed by horizontal sheeting and vertical inflation based on: 1) most are shallowly floored zoned batholiths with sheeted margins, 2) metamorphic aureoles record a history of increasing pressure from <0.3 GPa to >0.6 GPa, and 3) U-Pb geochronology indicated crystallization periods of as much as 8 Ma for individual batholiths, a consequence of construction by episodic pulses of magma.

A critical test for the magma loading hypothesis is to very accurately and precisely date the plutons and their contact aureoles using the latest geochronology methods to assess if a direct correlation can be made between pluton construction and aureole crystallization. Presumably, older portions of a pluton should correlate with the age of the earlier, lower pressure aureole assemblages, whereas younger pluton ages should approach the age of the higher pressure assemblages.

We dated 10 samples from plutons and two from smaller granitic bodies in the Harrison Lake area using the U-Pb zircon CA-IDTIMS method pioneered by James Mattinson. Prior to dating, CL images of zircon interiors were obtained to aid in selection of crystals or part of crystals devoid of complexities such as inherited cores and metamorphic overgrowths. The highly precise dates are concordant with internal errors on individual single grain analyses of ± 0.02-0.03%, which for most samples equates to ± 20-30 ka. The results allow us to significantly refine the ages of the plutons, some by 1-2 Ma and others by up to 50-100 Ma. Most plutons exhibit varying degrees of magma residence, with many having a range of zircon ages of 1 Ma. Some samples also suggest a prolonged period of emplacement of individual plutons between 1 to 12 Ma. These data point to a prolonged construction of the plutons, consistent with the magma loading hypothesis. Additional work will focus on detailed mapping in and around the plutons, structural and metamorphic analysis, petrology and geochemistry of pluton phases, and of particular importance, the age of metamorphism in contact aureoles.

Petrology of Ultramafic Xenoliths, Rayfield River and Big Timothy Mountain, areas, British Columbia

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Ultramafic xenoliths from Rayfield River and Big Timothy Mountain are interpreted to represent the underlying upper mantle. Both localities are Tertiary volcanic cones consisting of alkali basalt flows. The xenoliths are spinel lherzolites and less commonly harzburgites and pyroxenites. Mineral assemblages include olivine, clinopyroxene, orthopyroxene, and spinel. Microprobe analysis of the individual minerals determined the minerals were generally compositionally homogenous. A number of geothermometers have been assessed to determine the thermal conditions in which the peridotite equilibrated. Two-pyroxene thermometry, with the Brey and Köhler calibration, resulted in temperatures for Big Timothy that range from approximately 850ºC to 1040ºC, calculated at 15 kbar. Temperatures calculated, thus far, for Rayfield River range from ~930ºC to 960ºC. In addition, the equilibration relationships of both spinel-olivine and spinel-orthopyroxene are also assessed. With isochemical phase diagrams (pseudosections) and whole-rock analyses it is possible to constrain the P-T stability of Big Timothy peridotite. The calculated pressure range is ~10.5 to 13.5 kbar. This is also consistent with bracketed pressure range for Rayfield River xenoliths. The two-pyroxene equilibrium temperatures for the Big Timothy are calculated at 15 kbar and Rayfield River samples at 13 kbar. The effect of pressure on this calculation is negligible, temperatures change only ~2°C/kbar. In comparison with isochemical phase diagrams calculated with the program Theriak Domino, the equilibrium temperatures calculated fall well within the stability field of spinel peridotite. This is consistent with the observed mineral assemblage. Geothermal gradients for the Canadian Cordillera have been built by a number of researchers with the use of heat flow data and conductivity. The pressure and temperature conditions determined for the upper mantle from the peridotite xenoliths are consistent with the gradients that are used in this study. The peridotites represent residuum from the partial melting of the upper mantle. Compositionally, the peridotites from Big Timothy Mountain are fairly fertile with a MgO weight percent ranging from ~35-43% and Al_2O_3 around 3%; these largely correspond to 8-10% partial melting of primitive mantle. This

relatively fertile lherzolite represents upper mantle underlying the Canadian Cordillera. Based on the Rb-Sr isotope study, the melting event that produced the residuum occurred in the middle Proterozoic.

Iron isotope geochemistry of Rapitan iron formation: implications for genesis and global correlation

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Iron-formation occurs in many Neoproterozoic sedimentary successions where it is invariably associated with glacial deposition. These global occurrences of Neoproterozoic iron-formations are commonly correlated and linked to global seawater conditions related to glacial phenomena. However, age constraints are insufficient to confirm the correlations and no consistent model for the origin of the iron and the deposition of iron formation with relation to glacial processes has been elaborated. We have measured the iron isotope compositions and trace element concentrations of banded iron-formation (BIF) from the Rapitan Group, which was deposited during the older of two glacial episodes recorded in the Windermere Supergroup. The mineralogy of the Rapitan BIF is simple when compared to Archean and Paleoproterozoic BIFs, with iron residing almost exclusively in hematite. Sedimentological considerations indicate that the Rapitan BIF was deposited during a rise in sea level related to a period of glacial advance and isostatic adjustment. The iron isotope data show a coherent trend of increasing $d^{57}Fe$ (vs. IRMM-14) up-section, from ~ –0.7‰ to 1.2‰, which we interpret to record a steep isotopic gradient across the iron chemocline in the Rapitan glacial ocean. Based on this model, a similar iron isotope trend in the Sturtian Holowilena Formation of South Australia most likely does not document a global trend in seawater $d^{57}Fe$, but rather similar fundamental controls on iron isotope systematics during precipitation of Neoproterozoic iron formation.

Similarities between early Tertiary conglomerates along the Slate Creek and Duke River faults, Alaska and Yukon

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In the central Alaska Range, east of Paxson, early Tertiary conglomerate (ETC) outcrops within the Slate Creek fault (SCF) zone and also north of the SCF where it overlies flysch of the Gravina-Nutzotin belt and gabbro. The ETC consists of cobble to boulder conglomerate, sandstone, and minor plant fossils and coal, suggesting the ETC was deposited in an alluvial fan, braided stream, and lacustrine setting. Clasts include green porphyritic andesite, phyllite, foliated granitic rocks, and bull quartz. The ETC dips moderately to the north and has undergone significant strain, as indicated by crushed grains and ubiquitous slickensided hematite-stained clasts, suggesting the ETC was

deposited in a transtensional basin along the SCF. The ETC is thought to be the primary source of placer gold in the Slate Creek Mining district, hence the interest in its provenance.

The SCF zone lies 4 to 5 km south of and parallels the Denali fault system. In addition to the flysch and gabbro, other units exposed north of the SCF include the Nikolai Greenstone, Chitistone Limestone, and Early Cretaceous mafic and ultramafic plutons. Multiply deformed rocks of the Yukon-Tanana terrane (YTT) are found two km farther north, across the Denali fault. Rocks of the Paleozoic Skolai arc and Wrangellia lie south of the SCF.

Detrital zircon ages (105 grains) from a sample of the ETC fall largely in two ranges, 53-80 Ma and 95-120 Ma; there was only one zircon older than 200 Ma. As metaplutonic rocks of Mississippian to Devonian age are common in the nearby YTT and the Skolai arc also contains Paleozoic igneous rocks, old zircons would be expected if either contributed to the ETC. 53-80 Ma plutons are widespread in Alaska and Yukon; however, the nearest terrane that could yield zircons of this age and not also yield old zircons is more than 100 km to the east. Cretaceous plutons intruding Wrangellia south of the SCF could be a source for 95-120 Ma zircons in the sample. Singly deformed phyllitic clasts in the ETC do not appear to be sourced from the multiply deformed rocks of the YTT. Foliated granitic clasts are common in the ETC, but do not appear to be derived from the meta-plutons of the YTT. The lack of old zircons and absence of multiply deformed clasts in the ETC argues against the Paleozoic to Precambrian YTT as a source terrane. The lack of old zircons also suggests that the Paleozoic Skolai arc was not a source for the ETC, suggesting a nonlocal source for the ETC.

The Eocene to Oligocene Amphitheatre Formation outcropping 280 km to the southeast in Yukon appears similar to the ETC. The units are similar in depositional age, lithology, and depositional environment and perhaps had the same source terrane. Like the ETC, the Amphitheatre Formation is thought to be a placer gold source; numerous placer mines downstream of the Amphitheatre Fm. apparently source re-worked paleo-placers from the Amphitheatre (S. Israel, personal commun. 2009). Although the ETC and Amphitheatre Fm. most likely formed in discrete basins, the lack of likely local source areas for the clasts or detrital zircons in the ETC is problematic. Restoring possible offset along the Slate Creek, Denali, Totschunda, and Duke River faults could bring the ETC closer to the Amphitheatre Fm. and also to a possible source for 53-80 Ma detrital zircons and foliated granitic clasts in the similar age plutons of the Coast Mountains batholith. This also brings the ETC closer to the Kluane Schist, a possible source for the phyllitic clasts and gold.

Regional tectonic framework and metallogeny of the Coast Belt, southwest Yukon

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The Coast belt is a morphogeologic region that runs the length of the Canadian Cordillera. The Coast plutonic complex is found within the bounds of the Coast belt and comprises metamorphic and igneous rocks sandwiched between the Insular and Intermontane terranes. In southwest Yukon the Coast belt can be separated into three different tectonic elements that share a common Late Cretaceous-Eocene geologic history. These elements are: 1) the Yukon-Tanana terrane; 2) the Ruby Range batholith; and 3) the Kluane schist. In general, these three elements form a northeast-dipping structural stack with the Kluane schist occupying the lowest structural level and the Yukon-Tanana terrane occurring at the top of the stack. The Ruby Range batholith intrudes the boundary between these two metasedimentary successions. These tectonomagmatic relationships and the present erosion levels represent a crustal section at least 40 km thick.

From a field observation perspective, the Kluane schist can be divided into two distinct packages: 1) biotite-rich schist; and 2) muscovite-rich schist. The schists are strongly to very weakly carbonaceous. Locally, carbonate-rich layers occur as thin, discontinuous pods. Strongly deformed and altered ultramafic bodies occur locally in the central and northwestern portion of the Kluane schist. The general structural geometry of the Kluane schist mimics the regional framework with an overall northeast dip; however, the internal structural geometry is more complex with at least three phases of folding overprinting the main foliation. Preliminary detrital zircon analyses of quartz-rich layers within the biotite-rich schist suggest that the Kluane schist can be no older than ca. 94 Ma. Metamorphic overgrowths on almost all the grains indicate a major thermal event at ~82 Ma. A gneissic unit found structurally above the Kluane Schist has an uncertain geologic affinity, and may represent either migmatitic Kluane Schist or Yukon-Tanana terrane.

Rocks of the Yukon-Tanana terrane consist of two separate assemblages. A package of garnet-amphibolite, quartz-muscovite schist, marble and cream coloured, clean quartzite is likely correlative with the Snowcap assemblage, Late Devonian and older continental margin assemblage. A second package of carbonaceous, muscovite-schist, carbonaceous quartzite, marble and garnet-amphibolite likely belongs to the Late Devonian-Early Mississippian Finlayson assemblage. A cryptic, deformed, regional unconformity occurs between the two assemblages, with the Snowcap assemblage more prevalent in the northwest, while the Finlayson assemblage is more common in the southeast.

The Ruby Range batholith comprises variably deformed diorite to granite ranging in age from 64-57 Ma. In general, the batholith becomes more felsic at higher levels. The batholith is variably deformed near the base where it is in contact with the Kluane schist. Very large volumes of undeformed quartz-feldspar porphyry are found at the top of the batholith where it locally intrudes rhyolitic and dacitic volcanic rocks interpreted to be the extrusive equivalents of the batholith. The early stages of intrusion accompanied deformation related to southwest-directed thrusting of Yukon-Tanana terrane over the Kluane schist, while later phases are seen to cross-cut this boundary.

Present geologic architecture of southwest Yukon can be attributed to mid-Cretaceous southwest verging (present day coordinates) thrusting of Yukon-Tanana terrane over rocks of the Kluane Schist. This initial juxtaposition of terranes was responsible for the main metamorphic and structural elements found within the Kluane Schist. Progressive deformation during continued southwest verging compression deformed these elements into the general northeast dipping map patterns observed today. Locally the main northeast dipping structures have been modified by deformation related to later movement along the Denali fault.

Porphyry and epithermal style alteration and mineralization has been identified and is associated with the top several kilometers of the Ruby Range batholith. Gold mineralization is well documented in southwest Yukon and is associated with epithermal and orogenic mineralizing systems. The tectonic framework of southwest Yukon is similar to that found in southeast Alaska where several past and current producing gold deposits are found.

Identification of a crustal-scale extensional structure in the Cordillera of west-central Yukon

Ellie Knight, David Schneider, James J. Ryan, and Nancy Joyce

In the McQuesten area of west-central Yukon, strongly deformed mid-Paleozoic greenschist to amphibolite facies rocks of the Yukon-Tanana terrane are juxtaposed, along the Willow Lake fault, against relatively undeformed and unmetamorphosed Late Devonian to Early Mississippian plutonic rocks belonging to the polyphase Reid Lakes Complex and its overlying cover of coeval volcanic and volcaniclastic rocks. The fault is not exposed, but can be relatively well delineated by truncations in aeromagnetic data as well as by an outcrop of protomylonite. This abrupt truncation of lithologies with markedly different strain and metamorphic grade suggests that the Willow Lake fault may be a crustal scale discontinuity and is probably a normal fault dipping to the northeast. U-Pb zircon crystallization ages in conjunction with $^{40}Ar/^{39}Ar$ muscovite, biotite, and hornblende cooling ages and (U-Th)/He zircon cooling ages sampled along a transect perpendicular to the fault constrain the tectonothermal history of the region and help bracket the timing of movement on the fault. Devono-Mississippian U-Pb crystallization ages of zircon confirm age correlation of key foliated and undeformed geologic units on either side of the fault. In the undeformed Reid Lakes Complex, U-Pb zircon crystallization ages from 359.8 ± 2.4 to 342.4 ± 2.0 Ma coupled with $^{40}Ar/^{39}Ar$ cooling ages of biotite-hornblende pairs spanning 351.4 ± 2.7 to 349.8 ± 2.0 Ma confirm this plutonic suite intruded and cooled relatively quickly over 10 m.y. Distinctive lithologic similarity and a SHRIMP protolith age of 347.6 ± 4.0 Ma from the protomylonite indicate it is a strained component of the Reid Lakes Complex. The strong regional foliation that is truncated on the southwest side of the fault is well developed in granitoid bodies yielding 262.6 ± 1.3 to 261.9 ± 1.7 Ma zircon crystallization ages, suggesting the fault must be Permian or younger. Preliminary 197.0 ± 2.1 to 184.4 ± 1.2 Ma mica cooling ages in addition to 192.8 ± 5.2 Ma U-Pb zircon metamorphic overgrowths from the “footwall” suggest Jurassic fault displacement. Additional $^{40}Ar/^{39}Ar$ and (U-Th)/He cooling age analyses in progress from the McQuesten area will further constrain the low-temperature evolution of discrete fault domains in the region.

Volcaniclastic gravity flow deposits in the Dezadeash Formation (Jura-Cretaceous), Yukon, Canada: Implications regarding the tectonomagmatic evolution of the Chitina arc in the northern Cordillera of North America

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The Chitina arc in the northern Cordillera of North America evolved during the accretion of the Wrangellia composite terrane to the western margin of North America in the Jurassic and Cretaceous. The Dezadeash Formation, a 3000 m thick sequence of deepwater turbidites in southwestern Yukon, was deposited as a submarine fan in a backarc basin to the Chitina arc. Only limited geochemistry of altered volcanic rocks associated with the arc are available from southeastern Alaska. However, three thick volcaniclastic beds occur in the Dezadeash Formation. They consist of fine- to medium-grained vitric, crystal-vitric and crystal tuffs that are interpreted as resedimented syn-eruptive volcaniclastics. A U-Pb zircon age (149.4±0.3 Ma) indicates they are contemporaneous with the Chitina arc. Petrographic examination shows the volcaniclastic rocks are altered mainly by albite and locally calcite, and Harker diagrams indicate that CaO, K_2O and Rb were mobile. According to various trace element plots, the volcaniclastic rocks are calk-alkaline in composition, and similar to Nb-enriched, low Mg, adakites. They plot in the active continental margin field on a variety of tectonic discriminant diagrams, and chondrite-normalized multi-element plots display parallel, listric-shaped profiles with significant light rare-earth element enrichment and minor heavy rare-earth element enrichment. Sm-Nd systematics indicates the volcaniclastic rocks represent mixing of a depleted mantle source and an older crustal source. These data suggest mainly fractional control by hornblende and late feldspar of normal arc magma derived from partial melting of the mantle wedge, with possibly minor input by slab melting. The Chitina arc has previously been interpreted as an oceanic island arc, and the continental arc signature of volcaniclastic rocks in the Dezadeash Formation, together with a continental arc signature of the coeval altered volcanic rocks in southeastern Alaska (based on the Zr/Y vs. Zr tectonic discriminant diagram), is attributed to arc magmas erupting through Paleozoic sedimentary and plutonic rocks of the Wrangellia composite terrane proxying for continental crust.

Geological Investigations of the Basement of the Quesnel Terrane in Southern British Columbia

K Lucas and JK Mortensen (University of British Columbia), JWH Monger (Geological Survey of Canada Pacific, retired), and F Cordey (Université Lyon, France)

We have begun a study of Paleozoic oceanic rock assemblages that form the basement of the Early Mesozoic Nicola arc in the Quesnellia terrane in southern BC, focusing particularly on the Apex Mountain complex and the Kobau Group in the Keremeos-Osoyoos areas. The main goals of the study are: 1) to evaluate the current subdivision of lithotectonic assemblages in the region; 2) to determine depositional ages for the various assemblages; and 3) to assess the structural and possible stratigraphic relationships between the various assemblages. We are employing a variety of techniques, including micro- and macrofossil biochronology, U-Pb zircon dating, major, trace and rare earth element geochemistry, and detrital zircon dating.. We have collected a suite of 52 representative samples of basalts and related intrusive rocks for lithogeochemical study, 55 samples of clastic sedimentary rocks for detrital zircon dating, 6 samples of carbonate rocks for conodont dating, and a large number of samples of chert for radiolarian dating. Most of the lithogeochemical work is complete, and most radiolarian samples have been processed. Detrital zircon dating, conodont sample processing, and dating and isotopic work on the igneous rock units are in progress.

Radiolarian chert is a widespread and abundant lithology within the Paleozoic assemblages in the study area; however, microfossils in these units are typically too recrystallized to permit precise age assignments. New ages determined from radiolarian in cherts (determined by F Cordey), together with conodont ages from some of the cherts and from rare carbonate units in the area (determined by M Orchard), confirm that the main age range for the Paleozoic units in the area is from Late (locally Middle) Devonian to Carboniferous. This is the same age range that has been established by N Massey for the Knob Hill and Attwood assemblages in the Greenwood area. Older (Ordovician) carbonate blocks preserved west of Olalla appear to be either olistoliths from presently unknown sources that were incorporated during deposition, or exotic blocks that were structurally interleaved into the Apex Mountain complex. Similarly, Late Triassic carbonate bodies on Shoemaker Creek west of Keremeos appear to have been structurally sandwiched between older panels of Paleozoic rocks.

Major, trace and rare earth element compositions for mafic volcanic and intrusive rocks from all of the lithotectonic assemblages in the study area indicate mainly E-MORB to OIB signatures, with localized occurrences of arc and rare N-MORB rocks. It appears that most of the lithological assemblages in the area (e.g., Old Tom-Shoemaker, Kobau, etc.) contain volcanic units that were generated in more than one paleotectonic setting.

Siliciclastic rocks are a minor but widespread component of the Paleozoic assemblages in southern Quesnellia. Preliminary detrital zircon dating indicates that some of these units contain abundant Middle Devonian to Mississippian zircons, possibly supporting a depositional link with the Harper Ranch assemblage. The age range(s) of Precambrian detrital zircons in some of the samples that have been studied thus far are consistent with a source in northwest Laurentia; however, other samples contain abundant grains with ages that fall in the “North American magmatic gap”, possibly indicating a non-Laurentian affiliation.

An 811 Ma northwest-facing carbonate platform margin in the Fifteenmile Group of the Ogilvie Mountains

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In the Coal Creek inlier of the Ogilvie Mountains, Yukon, the Proterozoic Pinguicula Group is cut by NE-SW-trending, NW-side-down syn-sedimentary normal faults. These faults are sealed by mixed siliciclastic and carbonate strata of the Fifteenmile Group. The Fifteenmile Group is up to 2 km thick and divided into the ‘lower assemblage’, the ‘Craggy dolostone’, and the ‘Callison Lake dolostone’. The lower assemblage includes a volcanic tuff that has been dated with U-Pb ID-TIMS on zircons to 811.5 Ma. Olistostromes are common both along the synsedimentary faults in the Pinguicula Group and above these faults in the lower assemblage of the Fifteenmile Group. Slump folds that verge to the northwest are also present in the lower assemblage of the Fifteenmile Group. These two features are interpreted to be a product of the relief created during Pinguicula-age extension. During deposition of the lower assemblage, the margin stabilized, stromatolitic patch reefs grew on the horsts, and lagoons developed above the half grabens. With each shallowing-up sequence, stromatolite patch reefs nucleated into kilometer-scale barrier reefs. Organic-rich and sulfidic carbonate mud with molar-tooth structures formed inboard of the reefs and the entire carbonate platform prograded to the northwest. These shoaling upward sequences culminated with the deposition of the Craggy dolostone, a massive shallow-water dolostone which blanketed the margin. The Craggy dolostone and the Callison Lake dolostone are separated by a significant unconformity. The Fifteenmile Group is overlain by redbeds and conglomerate of the Lower Mt. Harper Group and the 717.4 Ma Mt. Harper Volcanic Complex.

We include the Fifteenmile Group in the Mackenzie Mountains Supergroup and correlate the lower assemblage and the Craggy dolostone of the Fifteenmile Group with the Little Dal Group. We also correlate the Callison Lake dolostone and the Lower Mt. Harper Group with the Thundercloud and Redstone River Formations of the Coates Lake Group. In this scenario, the Mackenzie Mountains and Shaler Supergroup formed on a northwest-facing rifted margin between ca. 850 and 780 Ma. The western margin of Laurentia was reactivated at ca. 780 Ma with the Gunbarrel magmatic event and the development of a major unconformity under the Callison Lake dolostone. This margin remained active through the Cryogenian period with the formation of transtensional rhombochasms accommodating the Coates Lake Group, the Lower Mt. Harper Group, and the 717.4 Ma (U-Pb ID-TIMS on zircon) Mt. Harper Volcanic Complex.

Tectonic Subsidence Variations in the Jurassic of west-central Alberta

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Tectonic subsidence curves were generated for over 200 wells in west-central Alberta to study the initiation of the foreland basin, as recorded in the Jurassic sediments in this area. A customized methodology for performing the calculations was used to facilitate a more detailed examination of the tectonic subsidence. This study reveals spatial and temporal variations in tectonic subsidence within the basin.

The tectonic subsidence curves were generated using subsurface well data extending from Township 30 Range 1W5 in the southeast to Township 71 Range 13W6 in the northwest, bounded to the west by the eastern limit of deformation and to the east by the Jurassic subcrop edge. The foreland basin extends to the west, into the fold and thrust belt, however wells from the fold and thrust belt have not been included here due to the complexity of generating subsidence curves through thrust-faulted layers.

Typical subsidence studies use less than 10 wells or locations. The volume of subsidence curves desired for this study required a customized methodology. The lithologies and their thicknesses were determined using well logs and exported to an excel spreadsheet. Macros were written to perform the decompaction and 1D backstripping needed to graph the tectonic subsidence versus age, using the equations described by Allen and Allen (P Allen and J Allen 2005). The calculated tectonic subsidence for the selected units was mapped.

Tectonic subsidence maps show a zone of increased tectonic subsidence in the southern part of the study area. This zone is present throughout deposition of the Nordegg, Poker Chip and Rock Creek Members of the Fernie Formation but begins to disappear during deposition of the Upper Fernie. Whether these variations are due to local or regional tectonics is under investigation at the time of writing this abstract.

References

Allen, P, and J Allen. 2005. *Basin analysis: principles and applications*. Second Edi. Blackwell Publishing.

Towards a Cretaceous paleogeography of NW Laurentia: untying the Tintina-Kaltag-Kobuk knot

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Alaska and Yukon are traversed by several major Cenozoic faults that obliquely truncate a complex distribution of terranes of different paleogeographic affinities. These include strike-slip faults such as the Tintina, Kaltag, Kobuk, and Denali faults in central and northern Alaska, as well as thrust faults at the leading edge of the Brooks Range – North Yukon fold and thrust belts. The relationship between these structures is not understood but is key to paleogeographic reconstruction. The Tintina is a northwest-striking dextral strike-slip fault with about 430 km of early Tertiary displacement. The trace of the Tintina converges with the merged traces of two northeast-striking faults, the Kaltag and Iditarod-Nixon Fork (KINF), with a cumulative displacement of about 220 km. Poor exposure characterizes the area of convergence. Some models portray the Tintina and KINF as a single fault system, connected through a 55 degree bend by the Victoria Creek fault. However, the disparity between KINF and Tintina displacements is great and coeval restraining bend structures sufficiently important to accommodate the difference have yet to be identified. Other interpretations consider the E-W-striking Kobuk fault a segment of the Tintina system offset by the younger KINF. In this interpretation, the KINF serves as the southern wrench boundary for the mid-Tertiary North Yukon thrust belt, required at a location near where the KINF would project through the Yukon Flats basin.

A new Cretaceous paleogeographic restoration, created using elements of previous kinematic models, yields insights into Laurentian - Eurasian terrane relationships. These include: 1) the eastern contact of the Eurasian Farewell terrane with the truncated edge of Laurentia is a post-Permian, pre-Early Jurassic structure; the lack of oceanic rocks along it suggests a strike-slip fault; 2) the timing of Farewell-Laurentian juxtaposition is similar to the re-attachment of Yukon-Tanana terrane to Laurentia by the closure of the Slide Mountain ocean, suggesting that the events may be kinematically linked, and 3) the timing of the Farewell-Laurentia juxtaposition means that Eurasian terranes attached to Laurentia on more than one occasion as the Arctic-Alaska-Laurentia boundary is a pre-Late Devonian feature.

Mid-Cretaceous dextral and sinistral fault systems in the northern Cordillera, northward escape of the Intermontane block, and the search for a plate tectonic moose-gooser

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With grateful acknowledgement of the contributions and inspiration of Hu Gabrielse and Jim Monger

The northern Intermontane terranes of south-central Yukon and northern British Columbia are dissected by a series of mid-Cretaceous (115-95 Ma) dextral strike-slip faults, including the Kechika, Cassiar and Teslin-Thibert-Kutcho faults. The main locus of displacement in northern B.C is on the Teslin-Thibert fault, where up to 130 km of dextral movement is inferred. Farther north in Yukon, this displacement is partitioned into a series of subsidiary faults, including the d'Abbadie, Big Salmon and Tadru faults, which show collectively about 125 km of dextral displacement. The Cassiar and Thudaka faults in northern British Columbia, which diverge from the southern extent of the Teslin fault, show about 80 and 50 km of offset respectively. Intimate relationships between faults and plutons of this age allow for precise dating of age of motion. The Cassiar fault was coeval with, and controlled the emplacement of the Cassiar batholith; K-Ar cooling ages on synkinematic muscovites are identical to U-Pb zircon ages of the batholith at 110-95 Ma (Gabrielse 1998). A new U-Pb age of ca. 107 Ma is presented here, from granite intruding but deformed by Cassiar fault-related structures. The d'Abbadie fault in Yukon is dated by the synkinematic Last Peak granite, which is 96 Ma by U-Pb methods on monazite (S.D. Carr *in* Gallagher, 1999).

Taken together, these faults account for approximately 250 km of dextral motion between the Intermontane region and parautochthonous North America. They are truncated by the Tertiary Tintina fault; their continuation northeast of it is a pattern of curvilinear dextral(?) faults and broad extension in the Selwyn fold and thrust belt, into the NW-directed Tombstone strain zone and Tombstone thrust. Total motion on this part of the system is not as well constrained, but is probably similar to the 250 km shown by offsets farther south.

By contrast, mid-Cretaceous transcurrent faults in the Coast Mountains, where they have not been overprinted by younger structures, are mostly sinistral. The Grenville Channel fault extends from Porcher Island in the north to at least the latitude of Bella Bella in the south, a distance over 300 km. It is a northwest-trending major sinistral/sinistral-reverse/sinistral-normal fault, with a broad associated mylonite zone, many splays and a very strong topographic expression. The previously-studied Kitkatla shear zone (Chardon et al., 1999) is part of this system. Motion on it is currently constrained between 123 Ma, the age of a thoroughly tectonised, metamorphosed intrusive complex in Matheison Channel, and 95 Ma, the age of an undeformed tonalite that is cut by a strand of the fault. Other constraints include offset of the ca 108 Ma Captain Cove pluton (Butler et al., 2006), and a synkinematic pegmatite at 103 Ma (J.B. Mahoney, unpublished data 2010). The amount of displacement and even its order of magnitude across the Grenville Channel fault system is difficult to determine, because the fault parallels the strike of transposed Alexander terrane units, and juxtaposes very similar mid-Cretaceous intrusive bodies.

Other mid- to early Late Cretaceous faults with sinistral shear sense have been documented farther south and east within the Coast Mountains orogen. The Pootlass shear zone near Bella Coola is developed within a 123-110 pluton; displacement is constrained to between 114 and 95 Ma based on U-Pb ages on deformed and undeformed dikes (Mahoney et al. 2009). Displacement magnitude is not known. Motion on the Tchaikazan fault is dated at 89 Ma, based on Ar-Ar dating of recrystallized illite from the fault zone; total displacement on this structure is between 40 and 180 km (Israel, 2001; Israel et al., 2006). The Cadwallader-Ferguson faults, which bound the Bralorne block, have sinistral motion that has been implicated in the formation of the gold-quartz veins; syn-ore dikes have been dated as 85-90 Ma (Leitch, 1990).

Comparing the ages of dextral motion on northwest-striking faults in the northeastern Intermontane region at 115-95 Ma with sinistral motion on northwesterly striking faults in the northern to southern coastal region at 123-85 Ma shows that they were generally coeval, with perhaps a slightly later persistence of sinistral motion to the south and west. Tectonic models of the mid-Cretaceous Cordillera must take these opposite senses into account.

The total amount of motion across the Coast Mountains orogen is debated. Other than the Tchaikazan, the studied faults, although impressive, do not show large amounts of demonstrable motion. However, in a landmark paper, Monger et al. (1994) laid out arguments that altogether the Insular block may have been displaced as much as 800 km to the south with respect to the Intermontane block. This interpretation receives strong support from the apparent duplication of mid- to Late Jurassic plutonic/volcanic belts in southern-central BC. The eastern belt ranges in age from 175 to 145 Ma. It is a suite of plutons that extends from the Omineca belt across southern Stikinia and Cache Creek terrane south of the Bowser basin. The belt as a whole cuts across the western edge of Ancestral North America and the three major Intermontane terranes at that latitude. In detail, plutons are synkinematic (ca. 175 in the Ominecas) to post-kinematic. They represent a magmatic arc that developed across the post-collisional continent margin. Its west-northwesterly trend is oblique to the terrane boundaries. The far northwesterly end of this trend is expressed by a suite of plutons in the eastern Coast Mountains south of Kitimat at latitude 54^{o} N. Plutons of this suite have been described by van der Heyden (1989) as post-kinematic to accretionary structures between the western Intermontane and eastern Insular blocks.

Westward extensions of the mid-Jurassic suite have not been identifed in the northern Coast Mountains except for a single ca. 139-148 Ma pluton on Banks Island (Gehrels et al., 2009). However, there are voluminous mid- to Late Jurassic plutons within the southwestern Coast Mountains (Journeay and Monger, 1994; Monger and McNicoll, 1993). The northern limit of these intrusions seems to be at about the northern end of Vancouver Island at latitude 51^{o} N. Gehrels et al. (2009) report one ca. 145 Ma date from a pluton at the latitude of Rivers Inlet (51^{o} 30' N); north of that their results show no Jurassic ages west of the Coast shear zone. The eastern limit of this belt of intrusions is well documented in the southern Coast Mountains. It ends abruptly against the Owl Creek and Harrison Lake faults (Journeay and Monger, 1994). East of these faults are the Bridge River terrane and the Tyaughton trough – as pointed out by Monger et al. (1994), an oceanic accretionary complex that closed through mid-Cretaceous time. It is intruded by voluminous Cretaceous bodies, but no mid-Jurassic plutons.

These implied sinistral offset of the northern margin of the mid-Jurassic plutonic belt from east of the Coast shear to west of the Harrison Lake/Owl Creek faults and Coast shear amounts to some 350 km – somewhat less than the originally proposed 800 km of Monger et al. (1994), but still significantly greater than the cumulative ca. 250 km displacement on the inboard, dextral mid-Cretaceous faults. It is therefore likely that the sinistral motion on the coast was the "driver" in the overall system of lateral displacements by impinging on the southern end of the Intermontane block, with the inboard dextral faults developing around its inner margin as it escaped to the north.

Further detail on the southward motion of the Insular block is provided by north- and northwesterly directed thrusts in the North Cascades (Monger and Brown, 2009). These faults carry Early Cretaceous melange and blueschist, and primitive oceanic and intraoceanic arc rocks of Late Jurassic age in their hanging wall – an assemblage that resembles the western Klamath Mountains, but has no correlatives in the Canadian Cordillera. Age of thrusting is constrained between 112 and 86 Ma, with the basal Windy thrust more closely between 93 and 96 Ma, because its motion is dated by the synkinematic Mt. Stuart batholith (Monger and Brown, 2009, and references therein). These authors advocate that the orogen-parallel collision between rocks of the southern Coast Mountains and the terranes of western Klamath affinity was the result of southward displacement of the Insular block to impinge on the western Klamaths.

In the reconstruction of Wyld et al. (2006), in the Early Cretaceous, the Columbian embayment did not yet exist, and the southern end of the Intermontane block lay adjacent to the Klamath Mountains. They did not consider significant southern displacement of the Insular block as part of their model. Here, we propose that the Insular block moved rapidly 350 km south to collide with the northwestern Klamaths, between 120 and 93 Ma. As it did so, it became an indentor into the margin at the (present) latitude of Washington and Oregon. The localized compression had two results:

1) Northward escape of the Intermontane block; and
2) Generation to the east of the greatest amount of contraction anywhere in the Cordilleran foreland, with deposition of the thickest synorogenic clastic deposits in the foreland basin (Gabrielse et al. 2006).

In terms of Pacific plate interactions, the inferred causative role of southward sinistral motion of the outermost coastal block, the Insular block, in forcing more inboard dextral displacements, contradicts the notion of locating the Kula-Farallon ridge near the northern end of the Klamaths (Wyld et al., 2006). In that scenario, the more rapid, oblique-dextral trajectory of the Kula plate would result in dextral coupling with the northern segments of the outer margin – the opposite of what is seen. The very complex mid-Cretaceous tectonic history of the Cordillera that is described here puts us, if anything, farther from using on-land events to interpret offshore plate movements. On the other hand, it provides a kinematically integrated model for understanding mid-Cretaceous faults, magmatic belts and related hydrothermal systems throughout the northern Cordillera.

REFERENCES

Butler, R.F., Gehrels, G.E., Hart, W., Davidson, C. and Crawford, M.L. (2006): Paleomagnetism of Late Jurassic to mid-Cretaceous plutons near Prince Rupert, British Columbia, *in* Paleogeography of the North American Cordillera: Evidence For and Against Large-Scale Displacements, Haggart, J.W., Enkin, R.J. and Monger, J.W.H., Editors, *Geological Association of Canada*, Special Paper 46, pages 171–200.

Chardon, D., Andronicos, C.L. and Hollister, L.S. (1999): Large-scale transpressive shear zone patterns and displacements within magmatic arcs: the Coast Plutonic Complex, British Columbia; *Tectonics*, Volume 18, pages 278–292.

Gabrielse, H., 1998, Geology of the Cry Lake and Dease Lake map areas, north-central British Columbia; Geological Survey of Canada Bulletin 504, 147 p.

Gabrielse, H., Murphy, D. And Mortensen, J., 2006, Cretaceous and Cenozoic dextral, orogen-parallel displacements, magmatism, and paleogeography, north-central Canadian Cordillera; *in* Haggart, J.W., Enkin, R.,J. and Monger, J.W.H., eds., Paleogeography of the North American

Cordillera: Evidence for and Against Large-Scale Displacements; Geological Association of Canada Special Paper 46, p. 255-276.

Gallagher, C.S., 1999, Regional-scale transposition and late large-scale folding in the Teslin Zone, Pelly Mountains, Yukon [M.Sc. thesis]: Ottawa, Ontario, Carleton University.

Gehrels, G., Rusmore, M., Woodsworth, G., Crawford, M., Andronicos, C., Hollister, L., Patchett, J., Ducea, M., Butler, R., Klepeis, K., Davidson, C., Friedman, R., Haggart, J., Mahoney, B., Crawford, W., Pearson D. and Girardi, J. (2009): U-Th-Pb geochronology of the Coast Mountains batholith in north-coastal British Columbia: constraints on age and tectonic evolution; *Geological Society of America Bulletin*, Volume 121, pages 1341–1361.

Israel, S.A., 2001, Structural and stratigraphic relationships within the Tschaikazan River area, southwestern British Columbia" implications for the tectonic evolution of the southern Coast belt; M.Sc. thesis, University of British Columbia, 129 p.

Israel, S.A., Schiarizza, P., Kennedy, L., Friedman, R.M. and Villeneuve, M., 2006, Evidence for early to Late Cretaceous sinistral deformation in the Tchaikazan River area, southwestern British Columbia: implications for the tectonic evolution of the southern Coast belt; *in* Haggart, J.W., Enkin, R.,J. and Monger, J.W.H., eds., Paleogeography of the North American Cordillera: Evidence for and Against Large-Scale Displacements; Geological Association of Canada Special Paper 46, p. 331-350.

Leitch, C.H.B., 1990, Bralorne: a mesothermal, shield-type vein gold deposit of Cretaceous age in southwestern British Columbia; Canadian Institute of Mining and Metallurgy Bulletin v. 83, p. 53-80.

Journeay, J.M. and Monger, J.W.H., 1994, Geology and crustal structure of the southern Coast and Intermontane belts, southern canadian Cordillera, British Colubmia; Geological Survey of Canada Open File scale 1:500,000.

Mahoney, J.B., Gordee, S.M., Haggart, J.W., Freidman, R.M., Diakow, L.J. and Woodsworth, G.W., 2009, Magmatic evolution of the eastern Coast Plutonic Complex, Bella Coola region, west-central British Columbia; *Geological Society of America Bulletin*, Volume 121, p. 1362-1380.

Monger, J.W.H. amd Brown, E.H., 2009, Tectonic evolution of the southern Coast-Cascade orogen, northwestern Washington and southwestern British Columbia; ms. in preparation for "Guide to Washington Geology" or some such title, edited by Eric Cheney.

Monger, J.W.H. and McNicoll, V.J., 1993, New U-Pb dates from southwestern Coast belt, British Columbia; in Radiogenic Age and Isotopic Studies, Report 7, Geological Survey of Canada Paper 93-2, p. 119-126.

Monger, J.W.H., van der Heyden, P., Journeay, J.M., Evenchick, C.A. and Mahoney, J.B.M. (1994): Jurassic-Cretaceous basins along the Canadian Coast Belt: their bearing on pre–mid-Cretaceous sinistral displacements; *Geology*, Volume 22, pages 175–178.

van der Heyden, P. (1989): U-Pb and K-Ar geochronometry of the Coast Plutonic complex, 53°N to 54°N, British Columbia, and implications for the Insular-Intermontane terrane boundary; unpublished PhD thesis, *The University of British Columbia*, 392 pages.

Wyld, S. J., Umhoefer, P.J. and Wright, J.E., 2006, reconstructing northern Cordilleran terranes along known Cretaceous and Cenozoic strike-slip faults: implications for the Baja British Columbia hypothesis and other models; *in* Haggart, J.W., Enkin, R.,J. and Monger, J.W.H., eds., Paleogeography of the North American Cordillera: Evidence for and Against Large-Scale Displacements; Geological Association of Canada Special Paper 46, p. 277-298.

Eclogite in the St. Cyr area, Yukon-Tanana terrane: Preliminary findings and future work

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The St. Cyr area, southern Yukon, is one of several localities in the Yukon-Tanana terrane where eclogite and blueschist assemblages preserve evidence of subduction-related high-pressure (HP) metamorphism, making its structural and metamorphic history significant for regional tectonic reconstructions. In the 1990s, several studies addressed the tectonic implications of eclogite in the St. Cyr area. The rationale for returning to the St. Cyr include its unclear terrane associations and the lack of robust thermobarametric and geochronologic data for the area. First, Fallas et al. (1998) mapped eclogite and amphibolite as part of the metaigneous Anvil allochthon and garnet-mica schists as part of the metasedimentary Nisutlin allochthon. Subsequent nomenclature changes included the Anvil allochthon as part of the Slide Mountain Ocean terrane and the Nisutlin allochthon as part of the Snowcap assemblage of the Yukon-Tanana terrane. If eclogites in the St. Cyr area are associated with garnet-mica schists of the Snowcap assemblage, then they formed in the overriding Yukon-Tanana arc crust, not the subducting Slide Mountain oceanic crust. Second, previous pressure (P) and temperature (T) determinations relied on classic thermobarametry, which provides only minimum pressures. Additionally, previous geochronologic studies of the St. Cyr and other eclogites in the Yukon-Tanana terran do not petrographically or chemically link zircon ages with eclogite facies metamorphism.

In order to address the issues outlined above, detailed field mapping at 1:20,000 is planned to determine whether the eclogite-bearing assemblage in the St. Cyr area is part of the Slide Mountain Ocean or the Snowcap assemblage. Fieldwork will focus on regional mapping, collection of structural data and kinematic analysis of the relationships between HP assemblages and their quartzofeldspathic host rocks, as well as Slide Mountain Ocean assemblages. Petrographic relationships and mineral chemistry will help define prograde and retrograde reactions using mineral growth patterns. These data will be used to establish P-T paths for rocks in the St. Cyr area using a phase-equilibrium modeling approach and *in situ* U-Pb SHRIMP geochronology like that of Berman et al. (2007).

Preliminary results from 3 weeks of reconnaissance work in the St. Cyr area include: 1) Field relationships that show that eclogite and amphibolite within St. Cyr outcrops are intercalated with siliciclastic tectonites and garnet-mica schists, all of which display penetrative deformation characteristic of the Snowcap assemblage. 2) A preliminary U-Pb SHRIMP zircon age of 271 ± 4 Ma and trace element zircon data with no Eu anomaly, indicating that eclogite facies metamorphism in the St. Cyr area is late Permian in age.

Proterozoic implications of the western extent of Dawson Thrust, Yukon

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Stratigraphic and structural relations along the 340+ km Dawson thrust suggest its synchronicity with two magmatic events. In the western Ogilvie Mountains the fault is the southern truncation of the 6+ km thick Proterozoic siliciclastic to carbonate shelf succession, the Yukon stable block (YSB). Additionally, by Cambrian time the fault separated the Selwyn Basin (south) from the Mackenzie Platform (north), without the 2-20 km width of intermediate slope facies that are present to the east in the Mackenzie Mountains. For this high-angle fault the putative older-over-younger relationship is relatively insignificant considering its length: the Hyland Group (Middle Cambrian and older) of its southern wall is faulted against Cambrian to Devonian Bouvette Formation to the north. The present geometry reflects Cordilleran (Laramide) contraction but the crustal-scale break is likely older, with contrasting relations. For example in one place the Quartet Group (old YSB) is juxtaposed with Hyland Group, a south-side-down stratigraphic offset of more than 4 km. Most prominently, however, the Dawson thrust separates a considerably telescoped southern structural domain (steep dips, isoclinal folds and north-directed thrusts characterize the 'Dawson thrust sheet'), from moderately dipping YSB strata

The basal unit of the Hyland Group possibly shares its origin with the Dawson thrust. This fault marks the northern boundary of a coarse sandstone succession correlated with Yusezyu Formation. It is lithologically and stratigraphically analogous to the lowermost unit of Kechika trough (northern BC) and the Hamill/Gog formations (northern Selkirk Mountains where its 575±25 Ma age is interpreted to mark continent separation). At about this time the Dawson fault was the steep edge of a truncated continental shelf. Yusezyu siliciclastics were likely transported along the margin, rather than across it.

In the western Ogilvie Mountains, bimodal volcanic occurrences suggest periods of episodic extension. Vents of the Mount Harper volcanic complex are aligned with a north-side down fault parallel to, and 3 km north of, the Dawson thrust. The start of volcanism is unknown but 718 Ma rhyolite and andesite overstep the underlying fault scarp. South of Dawson thrust, submarine flows and pyroclastic deposits (Dempster volcanics) form structural and stratigraphic lenses within upper Hyland and overlying basinal strata. Regionally they range from Middle Cambrian to early Devonian but direct dates are unavailable. The abundance and thickness of these lenses increases toward the Dawson fault.

Supercontinent Rodinia is considered to have broken up between about 820 and 750 Ma. During this time broad subsidence occurred in what is now northwestern Canada. The southern Ogilvie Mountains record a northwest-facing (present coordinates) margin around 812 Ma. The 780 Ma dyke swarm (includes the Tsezotene (Mackenzie Mountains) and Hottah (NW Canadian Shield) intrusions are part of a radial pattern centered southwest of the YSB. At 720 Ma domal uplift on Victoria Island (western NWT), extensive dykes (Franklin swarm) and Mount Harper volcanism imply a large igneous province in this region but tectonic movements during this period are unclear. The proximity of Mount Harper volcanics to the Dawson thrust could be more than coincidental if the fault was originally trans-tensional, opening a basin for Hyland

Group fill. The fault was a long-lived topographic break (shelf-basin margin), a locus for Early Paleozoic volcanism, and later a crustal weak zone during the Cordilleran orogeny.

New mapping in the Dawson Range - Whitegold district, Yukon

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The McQuesten – Northern Stevenson project is an ongoing regional mapping project of the Geological Survey of Canada (GSC) covering the Dawson Range - White Gold district of west-central Yukon between 2009 and 2012. It is being carried out under the auspices of the GEM Edges project; a collaborative initiative between the GSC, Yukon Geological Survey, BC Geological Survey, with partners in the USGS and academia. The McQuesten – Northern Stevenson project covers a wide swath across the intermontane Yukon Plateau, from the Tintina Fault in the east to the Alaska border in the west.

Regional bedrock mapping of southwest McQuesten and northern Carmacks map areas was conducted in summer 2009 and 2010, and recently released as Canadian Geoscience Map 7. That area was last mapped in the 1940's, and little was known about its mineral potential. Bedrock there is typically poorly exposed, thus a detailed aeromagnetic survey was acquired in 2009 to assist mapping of this region, and provide a valuable exploration dataset for the mineral industry. The northern two thirds of the map area is primarily underlain by rocks of the Yukon-Tanana terrane (YTT), exposed in two distinct northwest-trending belts separated by the Willow Lake fault. Southwest of the fault, YTT includes a variety of polydeformed and metamorphosed rocks that include: siliciclastic, pelitic (commonly carbonaceous) and carbonate sedimentary rocks; mafic, intermediate and felsic metavolcanic rocks; and a wide variety of metaplutonic rocks, ranging in composition from ultramafic to felsic. These rocks are typical of the regional character of YTT in Yukon which comprises a basement complex of pre-Devonian metasedimentary origin (Snowcap assemblage) overlain by three unconformity-bounded Devonian to Permian volcano-sedimentary sequences of predominantly arc affinity, and intruded by cogenetic plutonic suites. Northeast of the Willow Lake fault, YTT rocks contrast markedly with those southwest, and are essentially unmetamorphosed and undeformed. They comprise primarily intrusive rocks, and near the eastern limit of our map area, intermediate to felsic volcanic and volcaniclastic rocks coeval with the main plutonic body, the Reid Lakes batholith; both now dated as Mississippian. The Reid Lake complex has yielded Mississippian Ar/Ar ages, whereas rocks south of the fault yield Jurassic Ar/Ar ages. Stark contrast in state of strain, metamorphic rank, and Ar/Ar cooling ages across the Willow Lake fault implies that the fault has a large component of vertical displacement. The southern part of the McQuesten and northern Carmacks map area is primarily underlain by rocks of the mid-Paleozoic Boswell assemblage and Triassic arc assemblage rocks of Quesnellia. The Boswell includes intermediate metavolcanic rocks, amphibolite (± garnet), minor ultramafic rocks, and prominent marble bluffs south of the Pelly River. These rocks are strongly deformed and show evidence of retrogression of an earlier high-grade (amphibolite?) metamorphism. They are also characterized by a strong east-west structural trend that is discordant with the prominent northwest-trending structures in the YTT to the north. An Early Mississippian tonalite intrudes amphibolite of the Boswell assemblage in the northern Carmacks map sheet. The southwest corner of our map area is primarily underlain by augite-phyric volcanic rocks typical of the Semenof formation of Quesnellia (equivalent to Povoas formation of the Lewes River Group of Stikinia on the southwest side of the Teslin Fault), and Hbl granodiorite to monzogranite of the Late Triassic-Early Jurassic Aishihik plutonic suite. The volcanic rocks are commonly cleaved and show chlorite-grade metamorphic assemblages. Granitoids of the Aishihik suite are generally undeformed, commonly contain magmatic epidote, and represent the northwest extension of the Minto pluton which hosts the high-grade Cu-Au Minto mine.

In 2011, mapping will move westward through northern Stevenson Ridge map area into the central Dawson Range. The vintage of previous mapping in that area is early 1970's at a reconnaissance scale, with local 1:50,000 scale in the late 1980's to mid 1990's. Based on previous mapping and our own reconnaissance work in 2010, we believe the area to be underlain by a background of typical pre-Devonian to Permian YTT rocks, cored by the mid-Cretaceous Dawson Range Batholith (Whitehorse Plutonic Suite), with rare but metallogenically important late Cretaceous porphyry intrusions, and covered sporadically by late Cretaceous to Paleocene volcanic rocks. That area is currently a hot bed of mineral exploration, driven largely by gold, and there is high interest for an update of the geology map. A geophysical survey of northern Stevenson Ridge was also flown in 2009 in advance of this mapping, and has been integral in the planning for explorations programs over the last year. Nathan Hayward has completed a new high-resolution (100 m grid) compilation (Geophysical Compilation Project, Yukon Plateau) of existing, publically available aeromagnetic surveys, including: North-Central-South Stevenson Ridge, McQuesten, Stewart River, Brewery Creek, Mt. Nansen, Minto, Selwyn River (all levelled to the North Stevenson Ridge survey). This product will be a valuable tool for the ongoing mapping project, as well as for mineral explorationists.

Stratigraphy and structure of Yukon-Tanana terrane along the Early Mesozoic western North American continental margin, Tincup Lake area, southwest Yukon

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Mapping in the Kluane Lake area, southwest Yukon, by the Yukon Geological Survey and Geological Survey of Canada as part of the GEM – Edges project identified a belt of Late Triassic and older ophiolitic rocks (i.e. Doghead assemblage, Escayola, unpublished data, 2010) sitting structurally above, and infolded with, rocks of Yukon-Tanana terrane near its southwestern margin. As Yukon-Tanana terrane had been re-incorporated into Laurentia by Early Triassic time, the ophiolite was therefore obducted onto the Early Mesozoic western edge of the North American continent. Detailed stratigraphic and structural mapping at 1:10 000-scale was undertaken to better understand the tectonic evolution of the continental margin during and after ophiolite obduction.

The low- to medium-grade metasedimentary rocks are correlated with two and possibly three assemblages of Yukon-Tanana terrane. Quartzose psammitic schist of the Snowcap assemblage occurs in the northern part of the area, north of an east-striking normal fault. All of the rocks south of this fault, with the exception of the stratigraphically lowest unit belong to the Finlayson and/or Klinkit assemblages. The lowest exposed unit south of the afore mentioned fault is composed of a white to peach weathering orthoquartzite. It is overlain by a pebble to cobble metaconglomeratic unit with white to grey calcareous and minor dolomitic clasts in a white to peach quartz rich matrix. The base of this unit is matrix-supported, grades upwards to framework-supported and is overlain by white- to grey-weathering marble. A thin, discontinuous unit of carbonaceous argillite and schist overlies this marble. This carbonaceous unit is interpreted to be all that remains of the Finlayson assemblage. A metavolcanic chlorite schist, correlated with the Klinkit assemblage, overlies both the marble-quartzite unit and the carbonaceous schist, implying an unconformable relationship. This metavolcanic package becomes increasingly calcareous up section; near the top metavolcanic schists are interlayered with meter-thick calcareous layers and are overlain by a white- to grey-weathering marble. The marble is overlain by a unit of graded quartzofeldspathic psammite and ±biotite + muscovite schist layers, interpreted to have been deposited as turbidites. The stratigraphically highest unit is a dark grey- weathering, stylolitic marble. This entire assemblage of Yukon-Tanana terrane rocks lies structurally below the Doghead ultramafic assemblage.

Rocks of Yukon-Tanana terrane underwent at least three phases of deformation. An S_1 foliation, concordant with primary bedding, is defined by flattened calcareous clasts in the metaconglomerate. S_1 was folded by isoclinal F_2 folds. A penetrative S_2 foliation consisting of biotite, muscovite and chlorite is axial-planar to F_2 isoclinal folds, and occurs throughout all rock units. F_3 folds are north-vergent, gently plunging, open to close, and gently to moderately inclined .It is the F_3 folds that control the map pattern. Late,-open, upright, moderately south-plunging-east-verging F_4 folds caused the F_3 fold hinges to vary between east and west plunges. It is presently uncertain which, if any, phases of deformation may be associated with the tectonic emplacement of the Doghead ophiolitic assemblage; however, emplacement likely predated the F_3 folding event based on field relationships.

Three moderately south dipping brittle normal faults have strike lengths of up to 10 km. Where these faults cut through marble units, tectonic breccias have a characteristic rusty orange stain. Steeply dipping, unmetamorphosed and unfoliated dioritic to monzodioritic dikes trend 115° − 190°and crosscut folds and foliations. Steep, brittle, oblique strike-slip faults, spaced at 500 m to 2000 m and striking 140° − 160° cross cut all other structures and rock types. These faults are likely related to regional-scale (Eocene?) strike-slip faults bordering the study area which cut the roof of the Paleocene Ruby Range Batholith. These late brittle structures may have acted as fluid conduits and are potential targets for mineral exploration.

An Early Cretaceous orogen in the southeastern Canadian Cordillera: Its relationship to the Late Cretaceous to Eocene thrust belt

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In the southeastern Canadian Cordillera, an Early Cretaceous (ca. 140 – 100 Ma) orogen lies embedded in the internal part of the Late Cretaceous – Eocene Rocky Mountain fold and thrust belt. The Early Cretaceous orogen has: a 50 to 150 km wide fold and thrust belt with the Porcupine Creek Anticlinorium at its leading edge; a 500 km long by 2-100 km wide metamorphic belt outlined by dipping isogradic surfaces; and a late to post-tectonic "mid-Cretaceous" plutonic arc. Early Cretaceous metamorphism took place mainly under the broad, mostly low-grade, Middle Jurassic metamorphic-plutonic belt and, in part, overprinted it. The metamorphic core zone of the Late Cretaceous – Eocene orogenic belt lies to the west of the Early Cretaceous metamorphic belt and, in part, overprinted it and perhaps, in part, underlies it.

The ~300 km long Porcupine Creek Anticlinorium of the western Rocky Mountains is a detachment fold that formed above the Lower Cambrian orthoquartzite at the leading edge of the Early Cretaceous thrust belt. The basal detachment of the fold complex is also the Early Cretaceous basal décollement. In the northern part of the Porcupine Creek Anticlinorium a deeper basal décollement was activated within Neoproterozoic clastic rocks. It merged with the Ptarmigan décollement that linked the Monarch-Snaring thrust system with the décollement under the Malton basement complex west of Jasper. The Malton complex consists of several km-thick sheets of basement gneisses originally interleaved with cover rocks and imbricated in the Middle Jurassic. The Early Cretaceous basal décollement dips westward under the Purcell, Selkirk, Monashee and Cariboo mountains. The Late Creatceous – Eocene Rocky Mountain basal décollement underlies the Early Cretaceous orogen, and may be linked to major shear zones in Eocene core complexes of the internal zone. Pebbles derived from Lower Cambrian quartzite and Carboniferous cherty carbonate formations, typical of the Rocky Mountain Main Ranges, are found in the Early Cretaceous Cadomin conglomerate, a major marker of the foreland basin.

Contact relationships of the Kluane schist and adjacent rocks: evidence for an evolving tectonic boundary

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In southwestern Yukon, the Cretaceous Kluane schist separates peri-cratonic rocks of Yukon-Tanana terrane (YTT) to the east from exotic rocks of Insular terrane to the west. The highly deformed schist contains a mixed composition ranging from pelite to psammite. It was deposited in a syntectonic basin situated between the evolving margin of Laurentia and the Insular terrane and hence, it bears significance regarding the tectonic evolution of this part of the northern Canadian Cordillera. The purpose of this study is to present recently collected field evidence regarding contact relationships of the Kluane schist and adjacent rocks with U-Pb age data to constrain the evolution of this tectonic system.

Contact relationships of the Kluane schist with adjacent rock bodies are extremely variable and range from structural to intrusive. Structural contacts are associated with thrust faults responsible for interleaving ophiolitic ultramafic rocks and YTT rocks into the Kluane schist during deformation. Intrusive contacts are shown by Bt-Hbl-Qtz-dioritic/tonalitic bodies that intruded into the Kluane schist after deformation ceased. Gradational contacts exist and they are delineated by km-scale contact metamorphic aureoles that are either concordant or discordant with the orientation of the dominant foliation in the Kluane schist. In the main portion of the Kluane schist a concordant, inverted metamorphic aureole separates Msc-rich schist in the west from Bt-rich schist in the east. The late syn-kinematic, Early Paleogene Ruby Range Batholith (RRB) that intruded east of the schist is responsible for this metamorphic aureole. Similar metamorphic aureoles that are discordant with the foliation of the schist enclose Early Eocene Bt-Hbl-Qtz-diorite and Bt-Hbl-tonalite rocks that intruded into the schist. A relatively complex, gradational contact exists between three different rocks at the eastern limit of the Kluane schist. This contact incorporates Bt-rich Kluane schist in the west, Bt-Hbl-Crd-Fsp-Gnt-gneiss that contains variable amounts of quartzofeldspathic leucosomes in the center, and undeformed porphyritic Bt-Hbl-granitoid of the RRB in the east. U-Pb zircon age spectra for a sample of the intervening gneiss is similar to that of age spectra for the Kluane schist. Within the gneiss, morphology gradually changes from a miatexite migmatite in the west to a diatexite migmatite in the east. The miatexite bears textural and compositional similarities to that of the Bt-rich Kluane schist, while the diatexite appears more similar to granitoid bodies of the RRB. At their eastern limits, both units are intruded by undeformed Bt-Hbl-granitoid of the RRB.

The results of this study indicate that a portion of YTT was imbricated with the Kluane schist during deformation, similar to previous findings regarding the ultramafic rocks. Migmatitic gneiss that intervenes between the Kluane schist and the RRB likely represents a 'melt-in' isograd separating the highest metamorphic grade Kluane schist from igneous rock of the RRB, which intruded into the schist late during deformation. Intrusion of the RRB obliterated almost all evidence of an earlier relationship between YTT and the Kluane schist. Furthermore, the RRB imparted an inverted contact metamorphic aureole on a significant portion of the Kluane schist that is only slightly preserved due to younger intrusive bodies, which appear to impart localized metamorphic aureoles onto the Kluane schist.

Cretaceous deformation, metamorphism and exhumation within Yukon-Tanana terrane, west-central Yukon

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A linked structural, metamorphic and in situ U-Th-Pb geochronology study at Australia Mtn within the allochthonous Yukon-Tanana terrane, suggests a high-pressure (*c.* 9 kbar) amphibolite-facies metamorphic event at *c.* 119 Ma that is syn- to post-kinematic with respect to the development of a regional transposition foliation. This event was followed soon thereafter by a minimum of 2 kbar of decompression by *c.* 114 Ma. Australia Mtn is underlain by multiply deformed and metamorphosed continental margin sedimentary rocks and rift-related mafic intrusions of the Snowcap assemblage. The earliest phase of deformation and metamorphism is recorded in the core of multi-stage growth zoned garnets, wherein a sigmoidal inclusion trail indicates up to 90° of top-to-the-northwest non-coaxial shear, synchronous with the development of a composite transposition foliation (S_T) defined by aligned and segregated layers of biotite, quartz and plagioclase. Quantitative garnet isopleth diagrams indicate stage-1 garnet growth at ~550°C and 6 kbar and restrict continued growth along a P-T path of increasing T and decreasing P. With the absence of monazite inclusions within the garnet core, there is presently no age constraint on the timing of this metamorphic and deformational event. Stage-2 garnet growth occurs as inclusion-poor idioblastic to sub-idioblastic overgrowths on stage-1 garnet, with the boundary between the two marked by a large chemical discontinuity. Despite alignment of kyanite and staurolite parallel to S_T, the absence of pressure shadows and little evidence for the deflection of S_T around porphyroblasts of staurolite, kyanite and stage-2 garnet, suggests a kyanite-grade metamorphic event that is syn- to post-kinematic with respect to S_T. Thermobarometry applied to the rim of stage-2 garnet yields P-T conditions of ~650°C and 9 kbar. The timing of this high pressure metamorphic event is dated by in situ U-Th-Pb SHRIMP geochronology on monazite inclusions within staurolite and kyanite porphyroblasts, as well as elongate matrix monazite aligned parallel to S_T, that together form a 119 ± 0.8 Ma age population. Monazite that occurs together with staurolite and plagioclase within resorbed holes in garnet, and within a resorbtion halo between stage-1 and -2 garnet, forms a single age population at 114 ± 2 Ma, and is interpreted to date the breakdown of both stage-1 and stage-2 garnet during a minimum of 2 kbar of decompression following the 9 kbar stage-2 garnet metamorphism. Clockwise P-T-t paths, as well as porphyroblast growth that was both synchronous with the early development of S_T (stage-1 garnet) and with the higher-pressure waning stages of S_T development (stage-2 garnet), suggest metamorphism for both stage-1 and stage-2 garnet growth was a consequence of crustal shortening and thickening. Decompression recorded in assemblages at Australia Mtn could be linked to mid-Cretaceous (c. 112-108 Ma) regional extension documented in east-central Alaska.

Neoproterozoic and early Paleozoic correlations in the western Ogilvie Mountains

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Current stratigraphic, geochemical, paleomagnetic, paleontological, and geochronological investigations of sedimentary units in the Tatonduk and Coal Creek inliers of the western Ogilvie Mountains permit refinement of regional Neoproterozoic and early Paleozoic stratigraphy. Strata of the Pinguicula, Fifteenmile, Rapitan, Hay Creek, and "Upper" Groups are present in both inliers. Prominent unconformities are present between the Pinguicula and Fifteenmile Groups, within the Fifteenmile Group, and between the "Upper" Group and the variable overlying Paleozoic stratigraphy, representing at least three distinct tectonic events and basin-forming episodes. We propose redefining the Fifteenmile Group, abandoning the Tindir Group, and recognizing equivalent strata to the Coates Lake and Mackenzie Mountains Supergroup. The development of this new stratigraphic framework for correlating Neoproterozoic and Paleozoic strata of the Ogilvie Mountains simplifies the stratigraphic nomenclature in the Yukon and will help elucidate links between the stratigraphy of the northern Cordillera and inliers of the western Arctic.

Uncovering the Thor-Odin dome: LA-ICP-MS detrital zircon data from the Thor-Odin dome cover sequence and tectonic implications thereof....

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The structural culminations of the Thor-Odin and Frenchman Cap domes in the Monashee complex of south-eastern British Columbia comprise Paleoproterozoic Laurentian "basement" orthogneiss and paragneiss, and Proterozoic to Paleozoic predominantly supracrustal metasedimentary "cover" rocks. In both domes, a quartzite marker at the base of the cover rocks has been interpreted as: i) unconformable on basement, and, ii) the same unit in both domes. This formed a basis for correlating the two domes; it has been accepted that the two domes are part of the same basement domain and have a shared history. However, we question this because of differences in basement lithology and age, and timing of deformation and tectonothermal history. Detrital zircon U-Pb age data from three Thor-Odin dome quartzites (i.e. Mount Thor and Icebound Lake in the dome interior and Cariboo Alp on the SW flank) form a basis for comparisons with the basal quartzite in the Frenchman Cap dome. The Mount Thor and Icebound Lake quartzites have: major detrital zircon age populations between ~1.9 and 1.65 Ga; minor populations spanning 2.2 – 2.8 Ga; and minor populations >3.0 Ga. The youngest zircons indicate that the quartzites are younger than ~1.65 Ga. In comparison, the basal quartzite in Frenchman Cap is older than ~1.85 Ga, based on the presence of crosscutting igneous rocks, and should be interpreted as part of the basement with respect to

the Cordilleran orogen rather than as part of its cover. The Cariboo Alp quartzite has major detrital zircon age populations from 1.9 – 1.65 Ga and ~1.1 Ga, and minor populations between 1.2 – 1.4 Ga and >3 Ga. The youngest zircons indicate that the quartzite is younger than ~1.1 Ga. This quartzite is younger than the so-called basal quartzites in both the Thor-Odin and Frenchman Cap domes, and has a different provenance. Results of this study and comparisons with published data show that there are at least three quartzites of different ages in the unit previously thought to represent the basal quartzite marker horizon of the cover sequence overlying basement. Taken together with different ages of basement rocks, differences in peak metamorphism and style of deformation in the two domes, the LA-ICP-MS detrital zircon quartzite data support the conclusion that the Monashee complex is made up of two different basement domains that have different basement geology, cover sedimentation and tectonothermal histories as far back in time as the Paleoproterozoic and as recently as the Eocene.

Tectonothermal study of the interface between the Kootenay Arc, Priest River Complex and Purcell Anticlinorium in southeastern British Columbia.

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The geologically complex region of southeast British Columbia between Nelson, Salmo, Creston and the Canada-USA border straddles the tectonic interface between the pericratonic volcanic rocks of Quesnellia and distal marginal rocks of the ancestral North American margin. This tectonic juxtaposition and related events occurred in the Jurassic-Cretaceous during Cordilleran orogenesis. Recent and ongoing geological research in this area, conducted by the provincial and federal geological surveys, have produced an excellent mapping framework. These reveal the essential stratigraphic, macro-structural, magmatic and metamorphic elements of the region, as well as the distribution of the major mineral deposits. The current study aims to build on this research to develop a better understanding of the distribution, character and timing of these events, and their relationship to the diverse mineralization present in the area.

Understanding the multiple tectonic domains in the area, and how they interacted with one another during orogenesis will be a primary focus of this future work. The Kootenay Arc, Purcell Anticlinorium, and northern-most extension of the Priest River Complex all converge in an area around southern Kootenay Lake. Polymetamorphosed country rock in each structural domain has been intruded by voluminous granitoid bodies ranging in age from Jurassic to Eocene. The rocks have experienced several phases of deformation, both compressional and extensional, the latter manifested in major Eocene normal faults that juxtapose different tectonothermal domains. The geological diversity of this setting has resulted in a wide variety of ore deposits, including sedimentary exhalative base metals, intrusion-related precious metals, polymetallic skarns, REE-rich veins.

An overview of the geological data available for the area will be presented, accompanied by a discussion of some of the main unanswered questions that will be the target of this study. Preliminary field work conducted in August 2010 resulted in numerous samples being taken for microstructural analysis, microprobe chemical analysis and phase equilibrium modeling. Initial results of this research will be presented.